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[54] GYRICON DISPLAY WITH INTERSTITIALLY PACKED PARTICLES

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	298; 345/107, 10	08; 349/117, 188; 427/212,
		214; 364/4, 8, 15, 7

[56] References Cited

0/1070 T----

U.S. PATENT DOCUMENTS

Re. 29,742	8/1978	Tung	2/412
2,326,634	8/1943	Gebhard et al	359/540
2,354,018	7/1944	Heltzer et al	. 88/82
2,354,048	7/1944	Palmquist	40/135
2,354,049	7/1944	Palmquist	40/135
2,407,680	9/1946	Palmquist et al	
2,600,963	6/1952	Bland	49/58
2,684,788	7/1954	Bland	222/177
2,794,301	6/1957	Law et al	. 49/84
2,950,985	8/1960	d'Adrian	
2,965,921	12/1960	Bland	
2,980,547	4/1961	D'Adrian	
3,150,947	9/1964	Bland	65/21
3,222,204	12/1965	Weber et al	117/17
3,243,273	3/1966	Bland	
3,310,391	3/1967	Law	65/21
3,617,333	11/1971	Brown 1	17/35 R
3,648,281	3/1972	Dahms et al	340/373
3,795,435	3/1974	Schwab	350/105

3,915,771	10/1975	Gatzke et al	156/71
4,002,022	1/1977	Guillermo	. 58/126 R

(List continued on next page.)

OTHER PUBLICATIONS

Lawrence L. Lee, "A Magnetic Particles Display", *IEEE Transactions on Electron Devices*, vol. ED 22, No. 9, Sep. 1975, pp. 758–765.

Richard A. Strain, "Additive Color Mixture with Fluorescent Pigments and Special Illumination", Color Research and Applications, vol. 1, No. 3, Fall 1976, pp. 146–147.

N. K. Sheridon and M. A. Berkovitz, "The Gyricon—A Twisting Ball Display", *Proceedings of the S. I. D*, vol. 18/3 & 4, 1977, pp. 289–293.

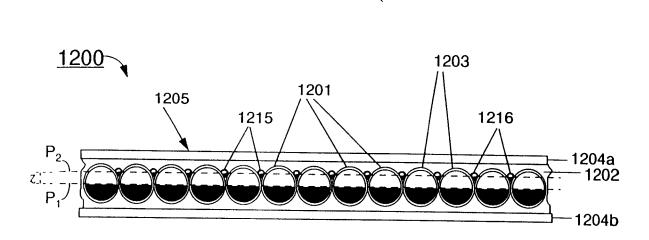
(List continued on next page.)

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[57] ABSTRACT

A gyricon or twisting-ball display having superior reflectance characteristics comparing favorably with those of white paper is based on a material made up of two populations (e.g., two different sizes) of optically anisotropic particles, such as bichromal balls, disposed in a substrate. Particles of the first population, as considered by themselves without the particles of the second population, are disposed in the substrate in a closely packed (e.g., geometrically regular) arrangement having interstices. Particles of the second population are disposed in the interstices of the arrangement. A rotatable disposition of each particle is achievable while the particle is thus disposed in the substrate; for example, the particles can already be rotatable in the substrate, or can be rendered rotatable in the substrate by a nondestructive operation performed on the substrate. In particular, the particles can be situated in an elastomer substrate that is expanded by application of a fluid thereto so as to render the particles rotatable therein. A particle, when in its rotatable disposition, is not attached to the substrate. A reflective-mode display apparatus can be constructed from a piece of the material together with a mechanism (e.g., addressing electrodes) for facilitating rotation of at least one of the particles.

27 Claims, 18 Drawing Sheets



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